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[56]

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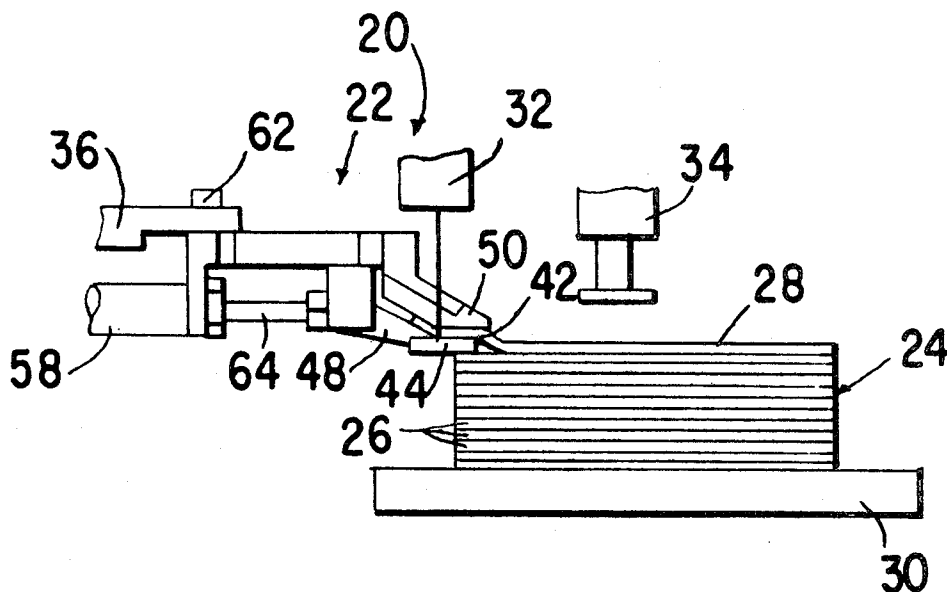
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[54] METHOD AND APPARATUS FOR REMOVING A SINGLE PLY OF FABRIC
1 Claim, 14 Drawing Figs.

[52]	U.S. Cl.....	271/19, 271/14
[51]	Int. Cl.....	B65h 3/32
[50]	Field of Search.....	271/19, 21, 22, 24, 25, 20, 14, 16

ABSTRACT: This disclosure relates to a method and apparatus for removing a single ply of fabric by means of a mechanical gripper. If there is a pile of fabric plies, the top ply will be separated from the rest of the pile which remains in a clamped condition to permit its sole removal from the pile by the mechanical means. Alternately, a single ply lying upon a support surface may be removed by a mechanical gripper having a jaw which passes under the piece by pivoting upon the support surface or entering a slot therein.



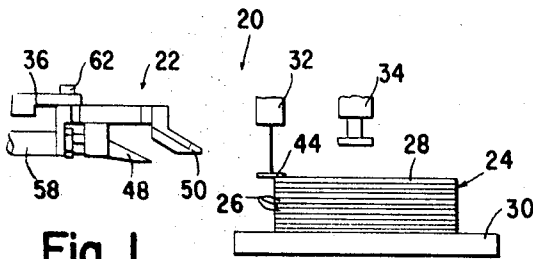


Fig. 1

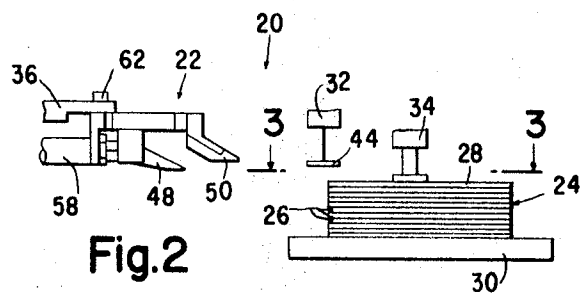


Fig. 2

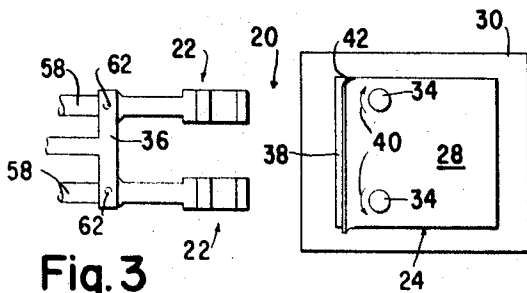


Fig. 3

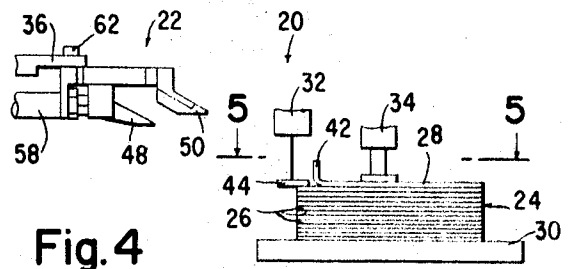


Fig. 4

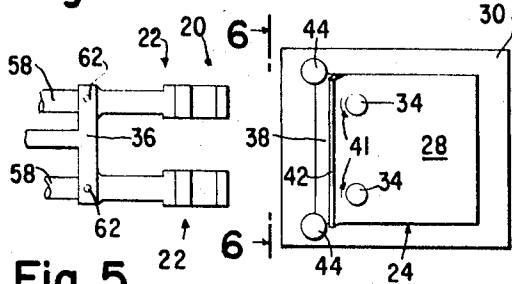


Fig. 5

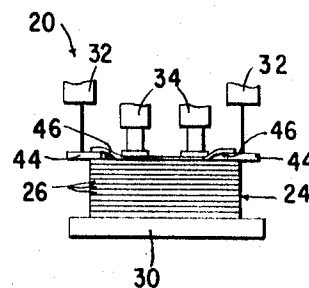


Fig. 6

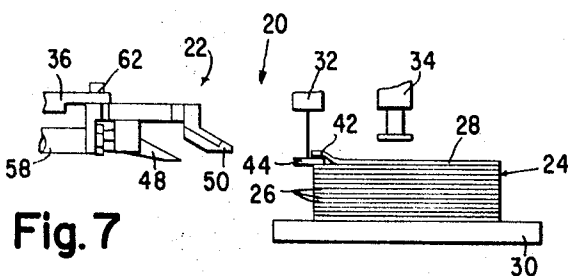


Fig. 7

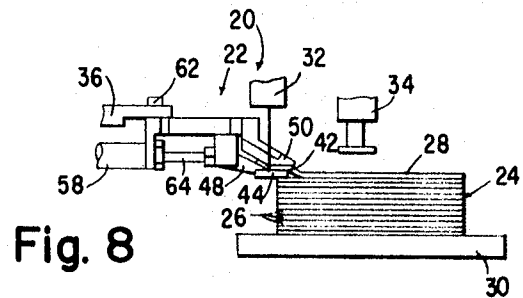


Fig. 8

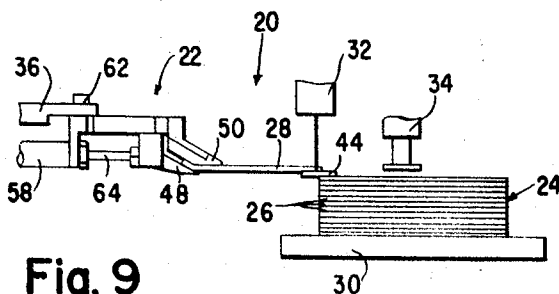


Fig. 9

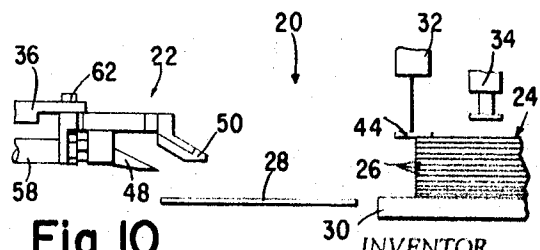


Fig. 10

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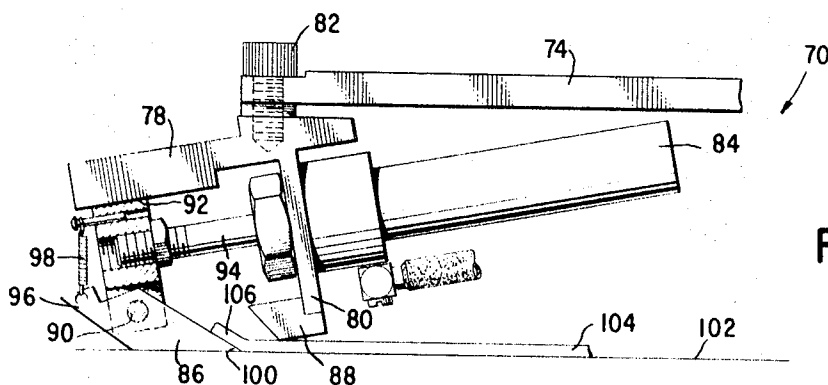


Fig. 13

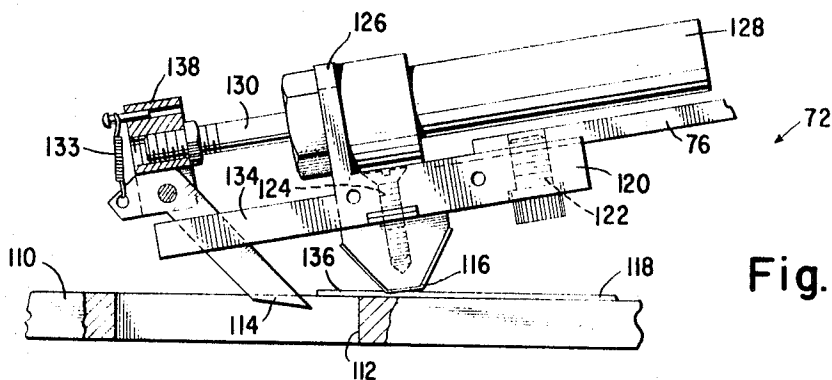


Fig. 14

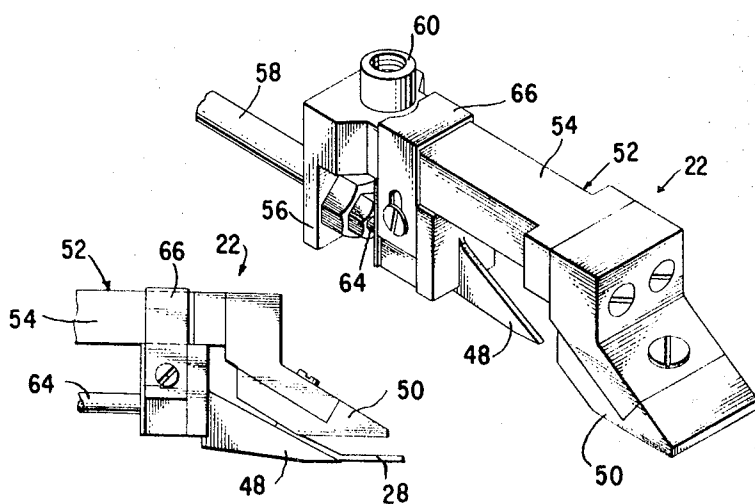


Fig. 12

Fig. 11

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METHOD AND APPARATUS FOR REMOVING A SINGLE PLY OF FABRIC

BACKGROUND OF THE INVENTION

Heretofore, material handling systems have been able to remove one or more plies in the system by means of conveyors or other rotary members, or by various clamping arrangements. In most instances, the pickup means were too costly or too complex or did not provide sufficient reliability in extended periods of use.

SUMMARY OF THE INVENTION

In accordance with the present invention, a method and apparatus is provided whereby a single ply of fabric may be successively removed. In the event the ply is in a pile, rotatable members will engage and lift the edge portion of the top ply to permit clamping of the remainder of the pile in the vicinity of the lifted edge. Upon release of the lifted edge, it will drape over the clamp to form an aperture between it and the remainder of the pile. A mechanical gripper extends into the aperture to seize and remove the top ply.

Alternately, if the ply is on a support surface, a mechanical gripper having a pair of jaws, one fixed and one movable, will seize the edge of the ply by passing the movable jaw under the ply to clamp the same against the fixed jaw. To facilitate the moving jaw sliding underneath the ply, it will be either made pivotal for point contact along the work surface prior to engagement with the ply, or it will enter a slot in the support surface over which the edge of the ply is disposed so as to initially be underneath the edge during closing of the mechanical gripper.

It is therefore, an object of the present invention to provide an improved method and apparatus for removing a single ply of fabric in a manner which overcomes the prior art deficiencies; which is simple, economical and reliable; which can remove a single ply whether the same is in a pile of fabric or individually placed upon a support surface; which separates the top ply from the pile to form an aperture in which a mechanical gripper may be extended to seize said top ply; which uses a mechanical gripper having a pivotal movable jaw; which has a mechanical gripper extending into a slot of a support surface to pass under the extended edge of the ply to seize the same; and which provides for positive removal of a single ply of fabric.

Other objects and advantages will be apparent from the following description of several embodiments of the invention and the novel features will be particularly pointed out hereinafter in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention is illustrated in the accompanying drawings in which:

FIGS. 1 through 10 show a schematic representation of one embodiment of the present invention wherein: FIG. 1 shows a side elevational view of the clamped pile of fabric; FIG. 2 shows a side elevational view of the pile of fabric prior to separation of the top ply; FIG. 3 is a top plan view taken along line 3-3 showing the lifting of the edge of the top ply from the unclamped pile; FIG. 4 shows a side elevational view of the pile being clamped while the edge of the top ply remains lifted; FIG. 5 is a top plan view taken along line 5-5 showing the rotary clamp returning to its original position to release the lifted edge; FIG. 6 is a front elevational view taken along line 6-6 showing the formation of the apertures prior to raising the rotary clamps; FIG. 7 is a side elevational view after raising of the rotary clamps; FIG. 8 is a side elevational view showing the mechanical grippers seizing the top ply after extending into the apertures; FIG. 9 is a side elevational view showing the mechanical grippers removing the top ply from the pile of fabric plies; and FIG. 10 is a side elevational view showing the mechanical grippers releasing the top ply with the pile restored in its initial condition of FIG. 1 for recycling,

FIG. 11 is a perspective view of the mechanical gripper shown in FIGS. 1 through 10 with the jaws thereof in open position,

FIG. 12 is a side elevational view of the mechanical gripper of FIG. 11, with the jaws in closed position.

FIG. 13 is a side elevational view of the second embodiment of the present invention showing another mechanical gripper,

FIG. 14 is a third embodiment of the present invention showing still another mechanical gripper.

DESCRIPTION OF THE INVENTION

The embodiment of the invention illustrated in FIGS. 1 through 10, depicts a removal system, designated generally as 20, which includes a mechanical gripper 22, the details of which are more fully shown in FIGS. 11 and 12. The removal system 20 operates upon a fabric pile 24 made up of a plurality of single plies 26, the top ply of which is designated 28. The pile 24 is placed upon a support surface 30, above which is mounted a pair of edge clamps 32 and a pair of rotary torque clamps 34. The clamps 32 and 34 are mounted to a suitable carriage (not shown) and adapted to be shifted vertically to maintain predetermined distances from the top ply 28. Alternately, the support surface 30 can be elevator actuated by any known means, (not shown) to maintain the desired spacing.

The mechanical gripper or pickup clamp 22 is connected to a movable frame 36 which normally positions it in spaced relation to the edge clamps 32 on the downstream side thereof.

In order to obtain the desired objectives of the present invention the removal system 20 is controlled by suitable electric and pneumatic control circuits (not shown), which will cooperatively act in a predetermined manner to permit the system 20 to operate in the sequential manner to be described hereinafter so as to effect removal of the top ply 28 from the pile 24.

The edge clamps 32 as shown in FIG. 1 will engage the top ply 28 to clamp the pile 24 at opposite sides thereof, with the rotary torque clamp 34 and the mechanical gripper 22 each inactive at the beginning of the cycle.

Upon lowering of the rotary torque clamps 34 to engage the top ply 28, the edge clamps 32 will be raised as illustrated in FIG. 2.

The rotary torque clamps 34, as shown in FIG. 3, engage the top ply 28 upstream from the front edge 38 and slightly inwardly from the side edges thereof. Each of the rotary torque clamps 34 will be turned in a direction away from the front edge 38 toward the side edge as represented by the arcuate arrows 40. The angle turned by each of the rotary torque clamps 34 is predetermined so as to create a buckling of the front edge 42 of the top ply 28, which having been placed in tension will lift upwardly and away from the fabric plies 26.

The rotary clamps 34 remain in the turned position with the front edge 42 lifted to permit the edge clamps 32 to be lowered as shown in FIG. 4 to reclamp the fabric plies 26.

The edge clamps 32 move in a vertical line and in clamped position will slightly extend over the front edge 38 and adjacent side edge of pile 24 so as to clamp the corner thereof. Restoring the rotary torque clamp 34, as represented by the arcuate arrows 41, to its unturned position releases the tension from the lifted edge 42 of the top ply 28 to permit the same to fall back upon the pile 24.

However, as is shown in Fig. 6 in the interim between lifting and releasing the edge 42 the enlarged heads 44 of the clamps 32 have been paced upon the pile and prevent the edge 32 from returning to its flat position. Instead, it will drape over a portion of the head 42 to form an aperture 46 bounded by the edge 42, the topmost ply 26, and the head 44. The rotary torque clamps 34 move in a vertical line and upon returning to their original rotary position will be removed from the pile, thus leaving the pile 34 in clamped condition, by the edge clamps 32, except for the top ply 28, as is illustrated in FIG. 7.

The mechanical grippers 22 are mounted in spaced pairs, each disposed on the inside of the edge clamps 32, in a position in line with the locality of the apertures 46 as shown in FIG. 5. Since the height of the pile 24 is predetermined the lower jaw 48 will be set at a height corresponding to the aperture 46, while the upper jaw is spaced above the lower jaw by an amount sufficient to enable it to pass over the edge 42 of the top ply 28 upon the lower jaw 48 entering aperture 46. Actuation of the mechanical gripper, as illustrated in FIG. 8 results in the top ply being seized between the lower jaw 48 and the upper jaw 50.

Once seized the top ply 28 will be removed from the pile 24 by the downstream motion of the frame 36 of the mechanical gripper 22 as shown in FIG. 9. Thereafter, the top ply 28 will be released from the mechanical gripper for subsequent handling or conveying (not shown) as desired, as illustrated generally in FIG. 10. The cycle may now be repeated so as to separate and subsequently remove the next top ply 28.

A preferred embodiment of the mechanical gripper is shown in FIGS. 11 and 12, in which the lower jaw 48 and upper jaw 50 are shown open in FIG. 11 and closed to seize a ply 28 in FIG. 12. The upper jaw 50 is affixed to the frame 52 having a narrow waist section 54 intermediate the upper jaw 50 and a mounting flange 56 for connecting an air cylinder 58 thereto. The mechanical gripper 22 may be screw connected to the frame 36 at boss 60 by threaded engagement with a screw 62 (see FIG. 1). The air cylinder is biased in open position and has a connecting rod 64 extending from the forward end thereof to actuate the lower jaw 48, the movement of which will be guided by a strap 66 slidably connected about the waist 54. On actuation of the air cylinder 58 the connecting rod 64 will urge the lower jaw 48 in the direction of the upper jaw 50 to achieve the closed position shown in FIG. 12.

If desired, the removal system 20 could use either a mechanical gripper 70 shown in FIG. 13 or a mechanical gripper 72 shown in FIG. 14. Each of the mechanical grippers 70 or 72 would require the motion of the respective connecting frames 74 and 76 to be from above and to the right of pile 24 represented in FIG. 1, to permit pickup of the desired top ply 28. On the other hand, if a single ply were to be removed from a support surface any of the embodied mechanical grippers 22, 70 and 72 could be used.

The mechanical gripper 70 includes a fixed frame 78 in which the mounting flange 80 is disposed below the screw 82 connecting the same to the movable frame 74. The flange 80 carries an air cylinder 84 biased in open position with the lower jaw 86 disposed in front of the upper jaw 88. The upper jaw is affixed to the underside of the flange 80. The lower jaw 86 is pivotally connected by pin 90 connected in the bifurcated end of a slide block 92 carried at the forward end of a connecting rod 94. The outer end 96 of lower jaw 86 biases the jaw clockwise by means of a spring 98 pin connected to the slide block 92. The clamping edge 100 is point-shaped in the direction of the upper jaw 88. The air cylinder 84 and connecting rod 94 are inclined at a slight angle to the support surface 102 upon which has been placed a single ply of fabric 104. The movable flange 74 will position the mechanical gripper 70 so as to have the upper jaw 88 clamp against the fabric ply 104 adjacent the forward edge 106 thereof. The lower jaw will upon contacting the support surface 102 to pivot to make full line contact therewith to place the point 100 thereof in pickup position so that it may slide underneath the forward edge 100 and 106 of the fabric ply 104 upon actua-

tion of the air cylinder 84 to effect clamping of the fabric ply 104. FIG. 12 shows the mechanical gripper 70 at a point in its operation where it has been actuated but has not as yet obtained a fully closed position.

The mechanical gripper 72 shows still another embodiment of the present invention, in FIG. 14. The removable frame 76 is disposed at a slight angle to the support surface 110 which is slotted as at 112 to permit the forward end of a movable lower jaw 114 to extend therein upon placing the upper jaw 116 in engagement with the fabric ply 118. The mechanical gripper 72 has a fixed train 120 screw connected as at 122 to the movable frame 76. The upper jaw is intermittently connected to the frame 120 as at by threaded means 124. A mounting flange 126 is extended upwardly from the intermediate location of the jaw to connect an air cylinder 128 biased in open position. A connecting rod 130 extends from the air cylinder 128 to connect into a jaw block 132 biased by a spring 133, and pivotally carries the lower jaw 114 in the bifurcated end thereof. A guide projection 134 extends forwardly of the flange 126 to prevent misalignment of the lower jaw 114. Upon actuation of the air cylinder 128 the lower jaw 114 is disposed beneath a forward edge 136 lying over the slot 112 thus enabling the jaw 114 to pass underneath and clamp the same against the upper jaw 116 for subsequent removal thereof.

It will be understood that various changes in the details, materials, arrangements of parts and operating conditions which have been herein described and illustrated to explain the nature of the invention may be made by those skilled in the art within the principles and scope of the invention.

I claim:

1. Apparatus for removing the top plies of a pile of flexible fabric plies comprising:

- a. a frame,
- b. a pair of rotatable means, each having an axis of rotation intersecting said pile and carried by the frame,
- c. means for moving the pair of rotatable means and the pile into and out of engagement with each other,
- d. means for simultaneously rotating the pair of rotatable means a predetermined amount with said rotatable means in spaced engagement with the pile to twist the topmost ply and displace one of the edges thereof from the remainder of the pile,
- e. a clamping means carried by the frame in superposition to the pile at the edge thereof corresponding to the displaced edge of the topmost ply,
- f. means for moving the clamping means and the piles toward and away from each other to effect clamping of the pile at the local of the displaced edge of the topmost ply to permit an initial separation to occur between the pile and the topmost ply at the clamped edge to form a space therebetween,
- g. a mechanical gripper means having a pair of coacting jaws carried by the frame.
- h. one of the jaws inserted into the initial separation between the pile and the topmost ply,
- i. the other jaw cooperating with the first jaw to grip the topmost ply therebetween, whereby the mechanical gripper means will remove the same, and
- j. control means to operate the pair of rotating means, the clamping means and the mechanical gripper means in a predetermined sequence to remove successive top plies from the fabric pile.